CLAIMS

1. A multi-antenna reception apparatus that receives by a plurality of antennas a plurality of modulated signals transmitted simultaneously from a plurality of antennas and reconstructs data sequences corresponding respectively to said plurality of modulated signals from the received signals, the multi-antenna reception apparatus comprising:

a provisional decision section that provisionally decides all or at least one of the modulated signals from the received signals;

a signal point reduction section that reduces candidate signal points for a subject modulated signal using provisional decision results with respect to the modulated signals other than the subject modulated signal; and

a main decision section that obtains digital data with respect to the subject modulated signal based on a signal point distance between reduced candidate signal points and reception points of the received signals.

2. The multi-antenna reception apparatus according to claim 1, further comprising a channel fluctuation estimation section that estimates a channel fluctuation value between each transmit antenna and receive antenna based on a known signal inserted in each modulated signal,

wherein:

said provisional decision section comprises:

a separation section that associates the modulated signal transmitted from each transmit antenna with the received signal received at each receive antenna using a channel fluctuation matrix comprising said channel fluctuation values as elements and carries out an inverse matrix calculation of said channel fluctuation matrix and thereby separates the received signal into the modulated signals transmitted from the respective transmit antennas; and

a decision section that obtains a digital signal by making a soft decision or a hard decision on each separated modulated signal and uses said digital signal as a provisional decision value; and

said signal point reduction section obtains all candidate signal points for said plurality of modulated signals multiplexed based on said channel fluctuation values, narrows down the candidate signal points for the subject modulated signal using said provisional decision value from all the candidate signal points and thereby reduces the candidate signal points for the subject modulated signal.

3. The multi-antenna reception apparatus according to claim 1, further comprising a signal point reduction

section that reduces candidate signal points for the subject modulated signal using digital data other than the subject modulated signal out of the digital data obtained by said main decision section.

4. The multi-antenna reception apparatus according to claim 1, further comprising a signal point reduction section that reduces the candidate signal points for the subject modulated signal using the digital data other than the subject modulated signal out of the digital data obtained by said main decision section,

wherein the candidate signal points are reduced by recursively using the digital data obtained by said main decision section sequentially.

5. The multi-antenna reception apparatus according to claim 1, wherein said plurality of modulated signals comprise signals modulated in such a way that reception quality varies between said modulated signals.

6. The multi-antenna reception apparatus according to claim 1, wherein said main decision section makes a decision using reliability of a decision made by said provisional decision section.

7. The multi-antenna reception apparatus according to claim 6, wherein said main decision section uses a path

metric of each symbol at said provisional decision section as said reliability and makes a decision with a branch metric weighted with said path metric.

8. The multi-antenna reception apparatus according to claim 1, wherein said provisional decision section classifies candidate signal points into a plurality of sets for each transmission bit and performs soft decision decoding using a minimum square Euclid distance between points of each set and the point of the received signal.

9. A multi-antenna reception method for reconstructing data sequences which correspond respectively to modulated signals from a received signal made up of a plurality of simultaneously transmitted modulated signals multiplexed on a propagation path, the multi-antenna reception method comprising:

a provisional decision step of provisionally deciding all or at least one of said modulated signals from said received signal;

a signal point reduction step of reducing candidate signal points for a subject modulated signal using provisional decision results with respect to the modulated signals other than the subject modulated signal; and

a main decision step of obtaining digital data with respect to the subject modulated signal based on the

reduced candidate signal points and the reception point of said received signal.

10. The multi-antenna reception method according to claim 9, wherein a rough decision is made in said provisional decision step and a detailed decision is made in said main decision step.

11. The multi-antenna reception method according to claim 10, wherein in said decision step, each modulated signal is separated by an inverse matrix calculation of a channel fluctuation matrix and each modulated signal after the separation is decided for each modulated signal and in said main decision step, a calculation including a maximum likelihood detection is carried out.

12. The multi-antenna reception method according to claim 9, further comprising a signal point reduction step of reducing candidate signal points used in said main decision step through iteration processing recursively using the digital data obtained in said main decision step.

13. The multi-antenna reception method according to claim 9, wherein in said main decision step, a decision is made using reliability of a decision in said provisional decision step.

14. A multi-antenna transmission apparatus comprising:

a plurality of antennas; and

an interleaver that interleaves signals transmitted from said antennas in different interleaving patterns.

15. The multi-antenna transmission apparatus according to claim 14, wherein the interleaving patterns of said interleaver is selected so as to have no correlation between the antennas.

16. The multi-antenna transmission apparatus according to claim 14, further comprising an OFDM modulation section that OFDM-modulates each transmission signal after interleaving,

wherein said interleaver selects an interleaving pattern in which data is arranged from low frequency subcarriers to high frequency subcarriers as a first interleaving pattern and selects an interleaving pattern in which data is arranged from high frequency subcarriers to low frequency subcarriers as a second interleaving pattern.

17. The multi-antenna transmission apparatus according to claim 14, further comprising an OFDM modulation section that OFDM-modulates each transmission signal after interleaving,

wherein said interleaver selects an interleaving pattern in which data is arranged from earlier times to later times in the time direction of subcarriers as a first interleaving pattern and selects an interleaving pattern in which data is arranged from later times to earlier times in the time direction of subcarriers as a second interleaving pattern.

18. The multi-antenna transmission apparatus according to claim 14, further comprising a space-time code insertion section that inserts space-time codes between data symbols.

19. The multi-antenna transmission apparatus according to claim 14, further comprising a special symbol insertion section that inserts special symbols having smaller decision errors than data symbol between data symbols.

20. The multi-antenna transmission apparatus according to claim 14, further comprising an antenna switching section that necessarily switches between the antennas for transmission at least once within a coded block.

21. The multi-antenna transmission apparatus according to claim 14, comprising an LDPC (Low Density Parity Check) coder instead of said interleaver,

wherein signals transmitted from said respective

antennas are interleaved in different interleaving patterns by changing a generation matrix of said LDPC coder.

22. The multi-antenna transmission apparatus according to claim 14, further comprising:

an OFDM modulation section that OFDM-modulates each transmission signal after interleaving; and

a signal assignment section that assigns signals transmitted from the respective antennas to subcarriers in different patterns instead of said interleaver.

23. The multi-antenna transmission apparatus according to claim 14, wherein said interleaver applies interleaving processing for every xth symbol to transmission signals transmitted from a first antenna out of said plurality of antennas and applies interleaving processing for every yth ($x \neq y$) symbol to transmission signals transmitted from a second antenna.

24. The multi-antenna transmission apparatus according to claim 23, wherein said interleaver applies interleaving processing in a block size equal to the least common multiple of said x and y.

25. The multi-antenna transmission apparatus according to claim 23, wherein said interleaver applies

interleaving processing using a prime number for at least one of said x, y.

26. The multi-antenna transmission apparatus according to claim 23, wherein said interleaver further applies interleaving processing whereby an offset is provided in the frequency direction or in the time direction between block interleaving on the transmission signal transmitted from the first antenna and block interleaving on the transmission signal transmitted from the second antenna.

27. A multi-antenna communication system comprising a multi-antenna transmission apparatus provided with a plurality of antennas that transmits different modulated signals from the respective antennas simultaneously and a multi-antenna reception apparatus provided with a plurality of antennas that reconstructs a data sequence which corresponds to each modulated signal by demodulating a received signal received using said plurality of antennas, wherein:

said multi-antenna transmission apparatus comprises an interleaver that interleaves signals transmitted from said respective antennas in different interleaving patterns; and

said multi-antenna reception apparatus comprises:

a provisional decision section that provisionally decides all or at least one of said

modulated signals from said received signal;

a signal point reduction section that reduces candidate signal points about the subject modulated signal using the provisional decision result about the modulated signals other than the subject modulated signal; and

a main decision section that obtains digital data about the subject modulated signal by calculating a signal point distance between the reduced candidate signal points and the reception point of said received signal.

28. The multi-antenna communication system according to claim 27, further comprising a space-time code insertion section that inserts space-time codes between data symbols.

29. The multi-antenna communication system according to claim 27, further comprising a special symbol insertion section that inserts special symbols having smaller decision errors than data symbol between data symbols.

30. The multi-antenna communication system according to claim 27, further comprising an antenna switching section that necessarily switches between antennas for transmission at least once within a coded block.

31. The multi-antenna communication system according to claim 27, comprising an LDPC (Low Density Parity Check) coder instead of said interleaver,

wherein signals transmitted from said respective antennas are interleaved in different interleaving patterns by changing a generation matrix of said LDPC coder.

32. The multi-antenna communication system according to claim 27, further comprising an OFDM modulation section that OFDM-modulates each transmission signal after interleaving,

wherein said interleaver assigns transmission symbols transmitted from the respective antennas to subcarriers in different patterns in the time direction or the frequency direction.

33. A multi-antenna communication system comprising a multi-antenna transmission apparatus provided with a plurality of antennas that transmits different modulated signals simultaneously from the respective antennas and a multi-antenna reception apparatus provided with a plurality of antennas that reconstructs a data sequence which corresponds to each modulated signal by demodulating a received signal received using said plurality of antennas, wherein:

said multi-antenna reception apparatus comprises:

a provisional decision section that provisionally decides all or at least one of said modulated signals from said received signal;

a signal point reduction section that reduces candidate signal points about the subject modulated signal using the provisional decision result about the modulated signals other than the subject modulated signal; and

a main decision section that obtains digital data about the subject modulated signal by calculating a signal point distance between the reduced candidate signal points and the reception point of said received signal; and

said multi-antenna transmission apparatus transmits a smaller number of modulated signals at the time of retransmission than modulated signals transmitted at any time other than retransmission.

34. The multi-antenna communication system according to claim 33, wherein said multi-antenna transmission apparatus forms said modulated signal using a space-time code or cycled delay diversity at the time of retransmission.